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EDWARD ORTON, GEOLOGIST*

By Professor A. C. SWINNERTON

ANTIOCH COLLEGE

INTRODUCTION

SCIENTISTS whose names survive are associated mostly with innovations. Newton and gravitation, Darwin and evolution, Agassiz and glaciation, are inseparable. Recognition is seldom granted the humbler role of the interpreter. Now and again, however, there arises an interpreter whose knowledge is so broad, whose judgment is so sound, whose touch with common folk is so full of understanding and whose integrity is so far beyond reproach that recognition is given spontaneously.

Edward Orton was an interpreter. As one studies his life one finds that Orton's contributions to education, to the state and to science lay largely in the wisdom gained from the discoveries of others, in the perception of values and in the interpretation of them to his fellow men. His contributions in geology can be understood and appraised only by an examination of the man himself; hence this review of his career in science must include a survey of his early years.

* Part of an address delivered at the dedication of a monument and park—a memorial to Edward Orton—presented to the State of Ohio by Hugh Taylor Birch, of Yellow Springs, Ohio, October 26, 1938.

I. EARLY YEARS

Edward Orton was born on March 9, 1829, when the presidency of the swashbuckling Andrew Jackson was but five days old. When he went to Hamilton College in 1845, conflict with Mexico was stirring emotions. All through his early years many conflicting views raged over political, economic and regional issues. The emotional tensions of people must have been similar in quality to those of our present day, the primary causes similar, though differing immensely in their applications. Candor in speech, honesty and objectivity in

judgment, tolerance in human relations and ethical discrimination were not the characteristic of that day any more than they are of our times.

Orton was the son of a minister, and it seemed natural and desirable for him to shape his career toward the ministry. With this end in view, after being graduated from Hamilton College in 1848, he entered Lane Seminary in Cincinnati. However, he remained at Lane less than a year, and a period of preparatory school teaching followed, during which he instructed mostly in the natural sciences. He spent a part of a year in the early fifties in the graduate study of chemistry and botany at Lawrence Scientific School under Eben Horsford and Asa Gray. But he still felt the urge to enter the ministry, for he next turned to Andover Theological Seminary. Here with his friend, John Bascom, he broke with orthodox creeds. But apparently he hoped that his views were not too extreme to be reconciled with institutional religion because in 1855 he was ordained in the Presbyterian ministry as pastor of the church at Downsville, N. Y. However, he held that pastorate only one year; his ideas were too liberal for the church of that day. Soon the New York State Normal School at Albany called him to the chair of natural science.

But Orton did not forsake his religious affiliations. He undertook the leadership of a Sunday School class in one of the Albany churches. It was still a few years before the great controversy between science and religion aroused by Charles Darwin's "Origin of Species," but the seeds of conflict were already present. There is nothing to indicate that Orton deliberately attempted to be provocative; in fact, his nature, whatever his views, would lead him to a more conciliatory attitude. Nevertheless, his religious teaching was sufficiently unorthodox to develop an undercurrent of criticism. His position in the State Normal School should have been free from sectarian influence, but such was the temper of the times that trouble brewed and Orton resigned.

The record is not clear where the fault lay. It is difficult to tell how much pressure for Orton's removal was brought to bear on the school officials, how much he was upheld or to what extent he was made to feel the desirability of withdrawal. But he was sensitive to the situation and would not allow himself and his personal views to become a public issue. His friends began a campaign through the press to embarrass the management of the school and to bring about his reinstatement, but Orton settled the matter by a long public letter[1] in which he assumed responsibility for the situation and absolved the school administration.

Following the trying episode at Albany he became principal of the academy at Chester, N. Y., where he remained six years. Here he formed an intimate friendship with Austin Craig, who was pastor of an independent church at Blooming Grove, near Chester. We know little of the association of the two men; however, in 1865, Craig, who was then acting president of Antioch College, in Yellow Springs, Ohio, invited Orton to become principal of the preparatory department of that college. One may read much between the lines: the influence of Horace Mann at Antioch, the tradition of liberalism in thought and religion, the broader scope of the curriculum which included the natural sciences as well as the classical subjects, the new spirit in education expressed in coeducation and in a variety of other ways. All this must have made Antioch seem like "green pastures." At thirty-six, with much troubled experience behind him, he was just at the threshold of his career.

II. Green Pastures

The history of Edward Orton's eight years at Antioch is available only in outline form. From the college catalogues of those years we learn that he was principal of the preparatory department and, beginning in 1866, also Artemus Carter professor of geology, botany and zoology.

Professor S. C. Derby has given us a brief impression of Orton's relationship to the administration at Antioch:

> It is . . . years since my acquaintance with Dr. Orton began—at Antioch College where he was then the most influential . . . member of its faculty. As an inmate of the President's household, . . . I had unusual opportunity to know how much that officer trusted to the practical wisdom of the alert and untiring professor of Natural History, who was also the head of the Preparatory Department. . . . Then as always Dr. Orton toiled terribly; much of the discipline of an unusually heterogeneous body of students rested upon him; his instruction was not confined to his chair . . . but regularly included Latin, with History or English or a normal class in Higher Arithmetic. . . . His pupils there, as everywhere, were inspired with a good measure of his enthusiasm and carried forward by the forcefulness of his teaching.[2]

At the age of 43 Orton was invited to become president of Antioch. The position of the young college was not well established. Its financial condition was never strong, and its reputation for liberalism did not help fill the coffers. Orton deliberated, for he was not an avid career-seeker, but he accepted.

There is little record of his brief period of presidency, for the next step in his career came quickly. Two decades later he wrote to President Long, of Antioch:

> I look back upon the years which I spent there as among the most enthusiastic and fruitful of a lifetime spent in

[1] *New York Tribune*, June 13, 1859.

[2] "In Memoriam Edward Orton," p. 55, Columbus, 1899.

teaching. There was a certain zest and charm in the work there that I have never found elsewhere. I hope that my successors find equal interest and inspiration.[3]

During Orton's stay at Antioch the second geological survey of the state was authorized by the Ohio Legislature, and Professor J. S. Newberry, of Columbia University, was made state geologist. That Orton's scientific interests and abilities were known outside of Yellow Springs was indicated when he was appointed one of the two assistant geologists. He was assigned southwestern Ohio for his district; and in the first few volumes of the second survey there appeared from his pen more than a dozen county reports. The enthusiasm with which he was regarded by the survey staff is related by one of the young aids—Grove Karl Gilbert:

> I had no opportunity to meet Dr. Orton until late in the season, when I had the good fortune to be bidden to attend a conference of the chiefs at Columbus. While on the journey from Cleveland Newberry prepared me for the meeting by sketching the quality and character of his colleague—a man without guile, direct in his conversation, and absolutely transparent as to motive. The simplicity of manner which would impress me at the start was not of manner merely but was a fundamental trait coordinate with and not contradicted by the wisdom which made him a man of affairs. . . .
>
> In later years, as we met from time to time, as I listened to his voice in public address or read the papers that emanated from his pen, I was able to add here and there a detail which Newberry's sketch had failed to delineate, but no line of it was ever erased, and Orton has remained, for me, one of the safest and most open-minded of investigators and the simplest, kindliest, and most lovable of men.[4]

In 1872, after many years of discussion and controversy, the land grant college of Ohio was at the point of selecting its faculty and of opening its doors. A department of geology and mineralogy was to be included, and Orton was invited to become its professor. The Ohio State University catalogue of 1890–91 in its section on history contains this statement: "Professor Orton declined the professorship of Geology, but in April (1873) succeeding the presidency of the institution was offered to him, which he accepted in May."[5] It is clear that Orton did not give up his commitment of service to Antioch lightly.

Of the history of the Ohio Agricultural and Mechanical College others must speak who have more intimate acquaintance and knowledge than I. To an outsider who has only the published records to read, there appear to have been two major problems facing the new enterprise, both of which required tactful but effective leadership. One was external—the jealousy with which the other educational institutions of the state regarded the new college; and the second—internal dissension among the friends of the institution regarding education policy.

Ohio was one of the last states to organize its land-grant college. In the institutions organized earlier in other states various policies had been followed; some interpreted the Federal Act as intending only vocational education. Neighboring Ohio colleges were struggling with finance and striving to maintain educational standards; it was natural that they should regard with concern the establishment of a low-cost institution, which, if the views of some of its supporters were followed, would change and probably lower traditional standards. To a considerable extent the selection of Orton as president spread confidence. His inaugural address, in which he espoused ardently the cause of breadth of academic training as opposed to purely vocational instruction, left no doubt of the policy he would pursue. His practice followed his preaching. In 1875 there were nine departments offering work chiefly in science and languages. Orton asked the board of trustees for the addition of instruction in history, economics, government and ethics ". . . that the symmetry of the education which we offer may very soon be completed."[6]

In 1878 came the confirmation of the policy which Orton was following. The name of the Ohio Mechanical and Agricultural College became the Ohio State University. As if this made certain the policies for which he had worked, Orton proffered his resignation from the presidency. It was tabled. Subsequent insistence on being relieved finally brought the acceptance of his resignation in 1881.

We must remember that during this period of the presidency Orton was involved in both the work of the State Geological Survey and the teaching of geology. The Newberry survey had become quiescent, for the condition of state finances precluded appropriations for more large volumes, and little systematic field work was in progress. Professor Newberry made fewer trips from New York, and to Orton was left the editorial work and other duties of the state geologist.

Orton was also carrying the responsibility for the geology department alone; he appears to have had no formal assistance until 1895, when J. A. Bownocker was listed as assistant in geology. His daughter writes:

> My father was a very hard worker and took his class work seriously, at all times. We must remember that he had none of the labor-saving devices such as the typewriter, the dictating machine, etc., on which teachers nowadays have come to depend. The manual work of writing out his lectures in longhand—and he was very

[3] "Letter to Daniel A. Long," January 11, 1895.
[4] "In Memoriam Edward Orton," pp. 21–22.
[5] Catalogue, Ohio State University, 1890–1891, p. 35, Columbus, 1891.
[6] Ohio Agricultural and Mechanical College, 4th Annual Report, p. 11, 1875.

careful to keep them . . . revised—plus his professional correspondence, kept him "burning the midnight oil" far too many nights.[7]

So effective was his teaching that his students and friends have perpetuated his memory in the building of Orton Hall on the university campus.

Such were the years of expanding responsibility and accomplishment. "Green Pastures" indeed, for Orton's abilities had found fertile soil and had made substantial growth. But his real career in geology was just beginning.

III. The Mature Geologist

When Edward Orton withdrew from the presidency of the university, he was 53 years of age. One can not help feeling that he was looking forward to the freedom from administrative responsibility. In addition to geology he had many private and community interests. He was a member of the First Congregational Church of Columbus and a close friend of the pastor, Washington Gladden, with whose religious view he was in close accord. He was concerned with municipal affairs and with many public institutions. Although these activities lie beyond the scope of this discussion, they emphasize his great breadth of human interest.

But in 1882 his chief geologic interests must have been his teaching and the continuation of the work of the State Geological Survey of which he was made director. Curiously enough, the geological work which was to constitute one of his major contributions to science was not yet apparent to any one.

In the work of the Geological Survey there were two major problems. The early survey which had been made of the coal measures, while satisfactory from the point of view of industry, was not adequate scientifically. It had been done independent of areas in adjacent states and was out of harmony; to use the geologic term, it could not be correlated. Orton undertook the re-study of the Carboniferous rocks and

> the outcome was that masterly presentation of the whole Carboniferous series of Ohio, in which the relations and variations of every prominent bed as it occurs within the state and adjacent portions of other states are presented in such fashion as to make the discussion distinctively one of the best . . . contributed to Appalachian geology. In this the awkward task of correcting the errors of those who had made the original observations is performed with a delicacy rarely equaled. . . .[8]

The second problem which apparently weighed on Orton's conscience was the promise made by the Geological Survey to publish information on the areal geology of the state, the stratigraphy, the paleontology, economic geology, and in addition agriculture, botany, zoology and even archeology. When Orton became director, only half of these items had been covered. Instead of reconstituting the survey and announcing new objectives when he was made director, Orton continued the second survey, and undertook to fulfil its promises.

It is noteworthy that from his interest in archeology and his inspirational contact with William C. Mills and E. O. Randall, there came the founding of the Ohio Historical and Archeological Society and eventually the Museum building on the Ohio State University campus.[9] Likewise, from his investigation of clays sprang the interest in ceramics which, through the efforts of his son, Edward, Jr., developed into a significant research and instructional department of the university.

An appraisal of Orton's work is particularly difficult to make, not because it was insignificant, but because he was an interpreter rather than an innovator. His work was done with little pomp and ceremony, and much was done by lecture, by letter and in personal interview. His published works were voluminous, but not in comparison with some of his contemporary geologists. In those days little restraint was exercised either in the length or number of published articles. His official reports frequently contain comment on commercial policies and practices, both public and private, of which he either approved or disapproved. One does not look for such "editorial" comment in scientific reports to-day, and yet it may well be asked if that frankness was not one of the most helpful of his public services in the protection of individuals as well as of public resources from wasteful losses.

The range of subjects covered in his writings is extensive. Aside from the county reports, and reports on coal and clay, already mentioned, he wrote extensively on oil and gas and on iron ores, building stones, salines, gypsum, lime, glacial gravels, hydrology and briefly on paleontology. In addition there are several papers of a general nature, such as "The Wastage of Our Coal Fields," and the presidential addresses before the Geological Society and the American Association for the Advancement of Science.

But the measure of the geologist is more than a summary of his publications. In order to understand his position in the world of geology let us review briefly the state of the science at the time Orton became state geologist. The great western explorations of the Powell, Hayden and King surveys had been made, and the results of these had been so significant in pointing the way to the development of the West that the organization of the United States Geological Survey was a natural consequence. Not only was there a great reaching out for the materials of an increasing industrialism

[7] Personal letter from Mrs. F. C. Caldwell, September 19, 1938.

[8] J. J. Stevenson, *Jour. Geol.*, 8: 210–211, 1900.

[9] Personal letter from Dr. Samuel Orton, September 28, 1938.

aided by geological explorations; there was also stimulated a tremendous growth in geological ideas. Large fields of knowledge which we accept to-day as part of the structure of geology were only then becoming known. Physiography was just emerging, inspired by the Western surveys and later interpreted by William Morris Davis in terms of peneplains and rejuvenated and dissected surfaces. Vertebrate paleontology was describing the great collection of Mesozoic and Tertiary bones from the Western foothills and sedimentary basins. The structural complexities of Appalachian mountain-building had yet to be disclosed by the detailed field work of Hayes, Willis and Keith. The use of rock thin-sections still in its infancy was already producing results of great scientific values. The interior liquidity of the earth was largely unquestioned, for the seismograph in embryo had indicated nothing of its power to probe the depths of the earth, and radioactivity was unknown.

This era of geologic discovery produced many great geologists and made many geologists great. We are interested in Edward Orton's place in that geological world of more than half a century ago. Obviously his place was not with those who were making scientific history by their discoveries in the mountains and in the Western plains. His position was assured by two great contributions: one which he planned as a necessary part of research, and one which came to him unexpectedly. The first was the detailed study and correlation of the Carboniferous strata of Ohio. This has already been mentioned in connection with Orton's work with the state survey. The significance of it need not be repeated; let me say only that it has served well as the foundation work for the geology of Eastern Ohio and adjacent regions.

The other enduring contribution related to oil and gas geology. It is a bit startling to be reminded, in these days of Gulf Coast and California gushers, that in 1886 Ohio had the largest oil and gas wells in the world. And all this development took place with startling rapidity. There was relatively little activity in these resources when Orton took over the state survey in 1882. By 1886 the Findlay field was the greatest producing field in the world; and so large was the relative production that the omnipotent Standard Oil Company was depressing the price, saying the market was glutted. Orton's official position gave him access to the drilling records and he was quick to learn the principles which underlie the occurrence of oil and gas. The anticlinal theory then recently propounded by White was found to fit the structural situation in Ohio, and Orton defended it stoutly. But that was not all. He studied the fragments the drill brought up and deduced the coincidence of the reservoir rocks with those parts of the Trenton limestone which had been changed to dolomite. He realized that these two factors, structure and rock character, together delimited the areas of production rather sharply.[10] He measured gas pressures conscientiously, contributing basically to our knowledge of "rock pressure."[11] He read voluminously, and in his writings he surveyed the whole field of both foreign and American literature critically. Reading his works over fifty years after they were written, one can not help being impressed with how little of significance has happened since—much change in detail, of course, but extremely little of basic principle. This impression is not just a vague sentimentalism. A text-book,[12] published late in 1937 in the field of hydraulics and carrying a chapter on oil field fluids, has a bibliography of 94 references for that chapter. Only 21 of those references were published prior to 1910; six of the works were written by Edward Orton and a seventh in collaboration with him! Only one other man in the whole list was referred to as many as four times. The test of time has certainly found his work of substantial quality.

During the height of his geologic activity, when he was returning to Columbus from a public lecture at Antioch, he was taken with a serious illness, which resulted in the paralysis of one side of his body. Despite this tremendous handicap he labored on with his teaching and research work unabated. Some of his most significant field work was accomplished following his illness. A letter which he wrote to a friend is characteristic of him:

> To any friends who inquire for me, I can describe myself in Scripture phrase as "faint yet pursuing"; overtaken by a severe physical disablement in the last public service that I undertook for the College, I have grown old, somewhat before my time. But "I bate not a jot of heart or hope." Life is still worth living, and the port well worth the cruise.[13]

His abilities were recognized by his contemporaries. In 1887, when it was planned to organize the American Geological Society, as an offshoot of the American Association for the Advancement of Science, Orton was made a member of the organizing committee.[14] This committee drafted a proposal for a constitution, which in 1888 was adopted with minor changes. This organization—the Geological Society of America—the leading society of its kind on this continent—celebrates this year its fiftieth anniversary. Edward Orton can be counted as one of its founders. Among the geolo-

[10] *U. S. Geol. Survey Ann. Report,* 8: pt. 2, 475–662, 1889.

[11] *Am. Jour. Sci.,* 3rd ser., 39: 225–229, 1890.

[12] C. F. Tolman, "Groundwater," Chapter XIV, New York, 1937.

[13] Letter to Daniel A. Long, January 11, 1895.

[14] H. LeR. Fairchild, "The Geological Society of America," p. 72 *et seq.,* New York, 1932.

gists famed for their remarkable discoveries in an age of great geological discovery, Orton was elected the ninth president of the Geological Society. No higher recognition was possible from geologists. But two years later, in 1899, the great body of American scientists—the American Association for the Advancement of Science—made him their president. During this year of office came his death.

So we come to the close of the career of that quiet man who loved nature, who loved his fellow men and who served both well. That statement might be said to summarize his philosophy of life. He had as part of it a philosophy of his science. Some elements of this have already been referred to—for example, his willingness to comment forcibly on the methods of commercial exploitation of geological resources, and he was outspoken regarding the "self-deception" attending oil and gas booms. In this way Orton interpreted his relation to his public trust.

In matters of pure science he also had convictions. He stressed the essential unity of geology and protested the lack of breadth of understanding which was beginning to appear in specialization.

> . . . the methods of investigation and research employed in the several sections of geological science are so diverse that it is quite possible for those who work in one to fail in due appreciation of . . . all the rest.
>
> But the putting asunder of things which belong together is always to be deplored. It will be an evil day for geology when, by a confusion of tongues, the utterances of its various builders become unintelligible to one another.
>
> . . . Geology still demands of its students a wide range of knowledge and interest. Its most substantial progress will be due in the future as it has been in the past, not to the level and clinometer alone, not alone to the sagacious interpretations of the relics of life, not alone to microscopic section or to chemical analysis, but to all combined. . . .[15]

In fact, he felt the essential unity of all science:

> Every road in science leads to the end of the world. You can write the history of the vegetable kingdom from the beginning of time, in telling the story of the hyssop that grows on the wall.[16]

Ordinarily tolerant, he had no patience with pretense or with hypothesis founded on fancy rather than fact; for example, this forthright statement:

> These conclusions (he is discussing the vegetable origin of coal) are questioned by no one who has a right to an opinion. Occasionally it is true, some belated denizen of the seventeenth century still attacks the problem of the origin of coal in the *a priori* way and evolves a theory of its formation from his own consciousness. Such theories do not require refutation. Like the seed sown in stony places, they speedily wither because they have no root. Inventions and not discoveries, they are quite likely . . . to go to their own place and be buried with their inventors.
>
> The formation of coal from vegetable growth I do not take to be an unsolved or unfinished problem.[17]

His mind was open toward the future, and on this note I wish to conclude the discussion of Edward Orton. Science is unending, nor is it complete apart from its spiritual relation to man. The interpretation of this concept is unsurpassed in his statement:

> All these things we *know*. Must not such knowledge "grow from more to more?" Can we not be sure that the little problems . . . which now rise before us as unfinished will sooner or later find their solution?
>
> But when they are solved, will all be known? Nay, verily. Out of these old Carboniferous swamps, new questions, larger, deeper than any we now see, will perpetually arise, to stimulate by their discovery and to reward by their solution, that *love of knowledge for its own sake* which makes us men."[18]

OBITUARY

JACOB GOODALE LIPMAN

IN the passing of Jacob Goodale Lipman, who died at New Brunswick, New Jersey, on April 19, 1939, the agricultural world and particularly the field of soil science has sustained a loss that will be felt not only in the United States but throughout the entire world of scientific endeavor for the improvement of agriculture through the development of basic principles and practices. Dr. Lipman was born at Friedrichstadt, Russia, on November 18, 1874, but was reared on a farm in southern New Jersey. He received his early training at the Baron de Hirsch Agricultural School and his B.Sc. degree from Rutgers College in 1898. After serving as assistant chemist at the New Jersey Experiment Station for two years he took up graduate work at Cornell, where he received his Ph.D. in 1903. In recognition of his distinguished service to agriculture he was awarded the honorary degree of D.Sc. by Rutgers in 1923 and by the Catholic University of Santiago, Chile, in 1930. After serving his alma mater in various capacities he was appointed director of the New Jersey Agricultural Experiment Station in 1911 and dean of agriculture in 1915, both of which positions he continued to occupy until the time of his death.

As dean and director, Dr. Lipman has always been active in the affairs of the Association of Land-Grant

[15] American Association for the Advancement of Science Proceedings, 34: 173, 1885 (1886).

[16] *Idem*, 180.
[17] *Idem*, 180–181.
[18] *Idem*, 197.

Colleges and Universities, and his advice and assistance have contributed greatly to the shaping of the policies and the guiding of the activities of this organization.

Beginning as a charter member in 1907 his interest and active support of the American Society of Agronomy has continued throughout the years.

In the midst of a busy administrative career Dr. Lipman not only continued his research activities but found time to serve as editor-in-chief of *Soil Science*, a journal which he founded in 1915 to serve as a medium for the publication of the results of basic soil investigations, and as associate editor of a number of scientific journals, both in this country and abroad. His publications include a long list of technical papers on soils, soil bacteriology and agronomy. In addition to membership in a long list of scientific societies, honorary technical fraternities and civic bodies, he was a corresponding member of the Swedish Royal Academy of Agriculture, French Academy of Agriculture, the Czecho-Slovakia Academy and other learned foreign societies. Dr. Lipman was a delegate to the International Institute of Agriculture at Rome in 1922, 1924 and again in 1926, and to the Third International Conference on Soil Science at Prague in 1922 and the Fourth Conference in Rome in 1924. His activities in connection with these international conferences on soil science resulted in his election to serve as president of the First International Congress of Soil Science, which was held in 1927 at Washington, and as chairman of the American delegation to the Third International Congress of Soil Science held in 1935 at Oxford, England.

In addition to those already mentioned, many honors came to him in the form of special assignments by the United States government to serve on special committees and his designation by state officials to serve on various boards and commissions concerned with public health and other matters of civic concern.

In recognition of his distinguished service in the interest of soil science, Dr. Lipman was designated in 1929 to serve as one of the representatives of the State Experiment Stations on a National Committee on Soil Erosion to formulate plans and make recommendations for a cooperative attack upon the soil erosion problem. Through the decade of development and transition from soil erosion to the broader concepts of a broad program of soil conservation he has contributed generously of his time and talent, always ready and willing to devote a day or two out of a busy week to conferences or field trips.

To his colleagues Dr. Lipman was a constant source of inspiration and friendly counsel and to his students a stimulus to the attainment of scholarship and the development of the research attitude of mind. So great was his enthusiasm for his work that the men under him or associated with him, even though they sometimes disagreed with him, caught the contagion and were inspired to higher achievements in their chosen field of soil science.

Those of us who were fortunate enough to obtain glimpses of his wholesome and well-balanced philosophy of life at various times and under different circumstances are fortunate. A young scientist who has not had the friendship of a man of Dr. Lipman's type is spared the grief that comes with his loss, but his life is lacking one of its greatest joys and the satisfaction that comes out of such associations.

A. G. McCALL

U. S. DEPARTMENT OF AGRICULTURE

ADOLF CARL NOÉ

AFTER thirty-six years of varied services to the University of Chicago, Adolf Carl Noé died quietly in his sleep early on the morning of April 10, 1939. Dr. Noé, who had been in charge of the field of paleobotany for sixteen years, was to have retired on October 1, and he was particularly anxious to put his scientific "affairs in order." Saturday, March 11, therefore, found him at his office busy working on the final chapter of what will doubtless be his most important scientific memorial—the Stutzer-Noé Textbook on Coal. There, in the midst of his labors, he suffered the paralytic stroke from which he was unable to rally.

Dr. Noé was born in Gratz, Austria, on October 28, 1873, the son of Adolf Gustav and Marie (Krauss) von Noé. He attended the University of Gratz from 1894 to 1897, and the University of Göttingen from 1897 to 1899, during which year he came to the United States. Entering the University of Chicago he received the A.B. degree in 1900, and the Ph.D., in Germanic languages, in 1905. Although he was originally interested in the sciences, and had been a "demonstrator" in paleobotany at Gratz, he found it easier in this country to obtain employment teaching languages. After a year of such work at Burlington, Iowa, where, on July 3, 1901, he married Mary Evelyn Cullatin, Dr. Noé became instructor in German at Stanford University. Returning to Chicago he was instructor and assistant professor of German literature (as well as an assistant librarian) from 1903 to 1923. At this latter date he found it possible finally to return to his field of original interest, and he became assistant professor of paleobotany. He immediately outlined a course of study and offered work in the departments of geology and botany. The following year he was promoted to an associate professorship and made curator of fossil plants at Walker Museum.

Even before Dr. Noé succeeded in making a place for his subject in the curriculum at Chicago, he had in 1921 become geologist on the staff of the Illinois Geological Survey. This position he occupied until

his death, his last active field season having been that of 1938. In addition, he had served in a similar capacity on the state surveys of Kentucky and Iowa. In 1927 he was geologist for the Allan and Garcia Coal Commission to Soviet Russia and did considerable pioneering work, especially in the Donetz coal basin.

In addition to the Stutzer-Noé Text now in press, Dr. Noé was the author of "The Fossil Flora of Northern Illinois," "The Golden Days of Soviet Russia" and "Ferns, Fossils and Fuels," as well as a number of shorter contributions. The now prominent study of "coal balls" was fathered in North America by Dr. Noé, and he and his students did much to bring it to its present position of importance. He was also an able technician, a student working under his direction having perfected the nitro-cellulose peel method for studying sections which now has such wide usage both here and abroad. Almost single-handed he assembled or obtained, through exchange, the paleobotanic specimens in the Walker Museum Collection. Thus he leaves a rich heritage of material collected on his numerous trips to coal mines in the central states, in Texas, in Mexico and in Russia. Probably more important, Dr. Noé for a number of years was essentially the only man in the New World offering complete training in paleobotany. Since, in addition, he had the ability to attract students of real promise, he leaves an active group of younger scientists who will be able to do what doubtless he himself might well have done had it not been for the quarter century Germanic literature hiatus in his scientific career.

In spite of the fact that his untimely death found him, like all good scientists, intensely dissatisfied with his own accomplishments, his worth was well appreciated in many quarters. He received the Sc.D. from Innsbruck in 1922 and, in 1923, the honorary Ph.D. from Gratz, as well as the gold medal of the University of Vienna. He was a member of the Société Géologique de France, the Geological Society of Mexico, and a fellow of the Geological Society of America as well as of the American Association for the Advancement of Science. He was vice-president of the Paleontological Society in 1931, and the same year held similar office in the Illinois Academy of Science. In 1927 he was chairman of the Chicago Section of the American Institute of Mining and Metallurgical Engineers, and in 1937 he was chairman of the Paleobotanical Section of the Botanical Society of America. In 1934 he became a research associate of the Field Museum and was responsible for the technical direction in the preparation of the museum's great reconstruction of a Carboniferous forest.

Dr. Noé engaged in many extra-curricular activities. He was an enthusiastic horseman, a redoubtable fencer and an expert marksman. For many years he coached the Chicago fencing team and was the instructor of the Rifle Club which he helped to organize. In 1921 Dr. Noé served as treasurer of the American Commission for Vienna Relief so successfully that the grateful nation bestowed upon him the Officers Cross of the Order of the Austrian Republic. Tall and distinguished, of noble birth, Dr. Noé was, in his joviality and innate kindness, kin to all mankind. He was as much at home with a simple coal miner as at the banquet tables of the great and near great. His fame as a raconteur was wide-spread, and his lectures, commonly illustrated with colored slides of his own manufacture, were in constant demand. That such a lovable character out of the "old school" will be keenly missed and kindly remembered, in many circles in addition to the scientific, is a poor understatement. His good friends were legion. They ranged from eight to eighty, from the impoverished to the affluent, from the uneducated to intellectuals.

Dr. Noé is survived by his wife and his daughters Valerie Noé and Mary Helen Noé Mulliken, wife of Professor Robert S. Mulliken, of the department of physics, University of Chicago.

CAREY CRONEIS

WALKER MUSEUM

RECENT DEATHS AND MEMORIALS

DR. CHARLES SUMNER HOWE, president emeritus of the Case School of Applied Science, Cleveland, died on April 18 at the age of eighty years.

DR. JACOB GOODALE LIPMAN, professor of agriculture at Rutgers University, dean of the College of Agriculture and director of the New Jersey State Agricultural Experiment Station, died on April 19 at the age of sixty-four years.

DR. THOMAS R. GARTH, since 1930 professor of experimental psychology at the University of Denver, died on April 20 at the age of sixty-seven years.

PROFESSOR HENRY BISSELL ALVORD, head of the department of civil engineering at Northeastern University, died on April 20. He was fifty-three years of age.

DR. CLARENCE FLOYD HIRSHFELD, chief of research of the Detroit Edison Company, died on April 19. He was fifty-eight years of age.

A PORTRAIT of the late Dr. William A. White, formerly superintendent of St. Elizabeths Hospital, Washington, has been presented to the hospital by the Rev. U. G. B. Pierce, president of the board of visitors, on behalf of Dr. White's friends and associates. Mrs. White has given to the hospital Dr. White's library relating to psychiatry and the general field of medical sciences.

SCIENTIFIC EVENTS

THE ROYAL RESEARCH SHIP "RESEARCH"

THE Royal Research Ship, *Research,* the non-magnetic vessel which has been built to the order of the British Admiralty, was launched on April 4. According to the London *Times,* the ceremony was performed by Mrs. H. Spencer Jones, wife of the Astronomer-Royal, in the presence of a large gathering. The religious service customary at the launching of a warship was conducted by the Rev. A. Shell, of Dartmouth. Lieutenant Commander D. H. Fryer, who will be captain of the *Research,* has received special leave from the Admiralty to make a voyage to Australia in one of the few remaining grain ships to gain experience of sailing ships in preparation for his new work.

In the meantime, the *Research* in brigantine rig will have made a voyage under sail to the United States to show herself to the Carnegie Institution, which was responsible for twenty years of similar work, and to begin her work where the American research ship *Carnegie* left off.

The heavy-oil engines, made by Petters, Limited, have been in course of construction for three years and are of bronze and aluminium—unfamiliar materials in Diesel engines—and much time has been taken and a great deal of money has been spent in obtaining satisfactory substitutes for the steel and iron which more generally go to the making of heavy-oil engines.

The task allotted to the *Research* demands that she shall be virtually non-magnetic. She has been built practically without iron or steel fittings. There are no steel cables. The cooking utensils are of aluminium. The baths are of teak. The ship's company of thirty-one persons will be required to submit their clothing and gear to inspection so that they may not take unwittingly on board any metal buttons or other possessions likely to affect the delicate magnetic instruments. With the engines likewise, it has been necessary to secure for them iron constitutions without using the ordinary magnetic iron and steel.

From 1909 to 1929 work was done on the *Carnegie,* which took readings and compiled records. That work still remains to be finished. The new wooden ship, with her non-magnetic engines, gear and, in the strictly physical sense, crew, will work in all the oceans, from the edge of the ice in the north to the edge of the ice in the south. She will endeavor to cross the tracks of the *Carnegie* where that ship recorded observations, and will make parallel records for comparison. The work may take a decade or more.

During the past three years the work of making four non-magnetic engines, three of which are for auxiliary duties, has proceeded. The fourth engine, which drives the propellers, develops 160 h.p.

The *Research* is a 770-ton sailing ship rigged as a brigantine with auxiliary engine. She will gather data on magnetic variation on behalf of the Admiralty, and the charts compiled will be made available to all nations in the interests of safe navigation for ships and aircraft. In the event of war the *Research* would carry letter of marque, signed by the Powers to protect her from attack. For her construction Booth and Company, of Birmingham, have supplied some of the heaviest non-ferrous sections produced by extrusion.

THE PUGET SOUND ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL workers in western Washington gathered at the University of Washington, Seattle, on March 10 and organized the Puget Sound Entomological Society. The objectives of the society are to promote the study of insects, arachnids and terrestrial arthropods in western Washington, and to promote the mutual welfare of the members through the exchange of ideas at meetings and field trips. Membership is open to persons of good character who are engaged in entomological activities. The society will hold two regular meetings annually, in February and October, the precise time and place to be determined by the executive committee, which is composed of three elective officers. The present officers are: Professor Trevor Kincaid, University of Washington, *president;* S. E. Crumb, entomologist, Bureau of Entomology and Plant Quarantine, *vice-president,* and Dr. E. P. Breakey, entomologist, Western Washington Experiment Station, *secretary-treasurer.* Special meetings may be called by the executive committee at such time and place as it may determine.

The organization of the Puget Sound Entomological Society was the result of a movement initiated in the autumn of 1938 by Dr. Breakey. Thirty-two persons with entomological interests, both professional and amateur, gathered in Puyallup on November 18, 1938. Many spent the afternoon visiting the Western Washington Experiment Station and the U. S. Bureau of Entomology and Plant Quarantine Field Stations in Puyallup and Sumner. In the evening the group gathered for dinner, after which a discussion was held on the desirability of forming a permanent organization. Dr. Breakey was elected provisional chairman and Charles F. Doucette, Bureau of Entomology and Plant Quarantine, Sumner, provisional secretary. The chairman appointed a committee on organization, Professor Melville H. Hatch, University of Washington, *chairman,* to present a constitution and by-laws for discussion and approval at the next meeting. A nominating committee, W. W. Baker, Bureau of Entomology and Plant Quarantine, *chairman,* was also appointed. The October meeting is to be held in Puyallup.

THE SEVENTIETH ANNIVERSARY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE American Museum of Natural History celebrated on April 6 the seventieth anniversary of its founding. It was organized on April 6, 1869, under the leadership of Albert S. Bickmore, first president of the museum. From 1869 to 1877, the home of the museum was in the Arsenal in Central Park. The cornerstone in Manhattan Square, bounded by 77th Street, 81st Street, Central Park West and Columbus Avenue, was laid in 1874. To-day, with the addition of new buildings and wings, the value of the buildings is approximately $16,000,000.

The museum was erected almost entirely by the city, which also provides approximately a fifth of the funds annually required for maintenance, the balance being provided for by the endowment foundation, which is dependent mainly upon the contributions of trustees, members and friends.

President F. Trubee Davison, in discussing the early days of the museum, said:

> As life on earth has small beginnings, so had the American Museum of Natural History. During the first year of its existence, $44,500 were subscribed by citizens. By means of this sum the museum was able to purchase four collections consisting of 9,300 mounted birds, 200 fish and reptiles, 820 mounted animals, 4,000 mounted skeletons of mammals, birds, reptiles and fish and 250 specimens of Siberian fauna. The subsequent history of the museum has been one of almost continuous progress in its chief fields of exploration, research, preparation, exhibition, education and publication. To-day the floor space of the museum covers almost twenty-five acres, out of which more than half a million square feet are covered by exhibits in a total of some 60 exhibition halls and corridors.
>
> The number of specimens in the various exhibits and collections runs into many millions and covers virtually every field of the natural sciences illustrating life on land, in the sea, in the air and from the prehistoric past to the history-making present. The museum has done and is doing important work in research and publication, and in education from the primary school to the highest university grade. As a part of its educational program, it maintains a department of education which works in conjunction with the city's public schools and with other institutions, including those for the blind.
>
> For seventy years the American Museum has been building up a treasure-house of facts from all parts of the world, as well as from such intangible realms as psychology, human and animal behavior and the heavens above. These collections are adequately housed in our great museum buildings, but great as these collections are and generally unsurpassed as they are, much remains to be collected. Probably that task will remain uncompleted to the end of time, for knowledge has no limits, but every effort should be made day by day and year by year to fill in the gaps and further enrich the treasure-house. To accomplish this it is necessary for the museum to increase its operating funds and its endowment. Two years ago the museum adopted a ten-year development program which calls for an increase of $10,000,000 in endowments. The income from this fund would be spent in developing the museum's activities in all its branches.

THE AMERICAN PHILOSOPHICAL SOCIETY

AT the annual meeting of the American Philosophical Society, held at Philadelphia on April 20, 21 and 22, the following members were elected:

Class I—mathematical and physical sciences: Jesse Wakefield Beams, University, Va.; William Mansfield Clark, Baltimore; Arthur Byron Coble, Urbana; Enrico Fermi, New York; Charles August Kraus, Providence; Paul Willard Merrill, Pasadena; Stephen Timoshenko, Stanford University; John Hasbrouck Van Vleck, Cambridge, Mass. *Foreign:* Prince Louis Victor de Broglie, Paris; Godfrey Harold Hardy, Cambridge, England.

Class II—geological and biological sciences: Eliot Blackwelder, Stanford University; William Bosworth Castle, Boston; Wolfgang Köhler, Swarthmore; William de Berniere MacNider, Chapel Hill; Theophilus Shickel Painter, Austin; Peyton Rous, New York; Edmund Ware Sinnott, New York. *Foreign:* Sir Henry Hallett Dale, London, England; Johan Hjort, Oslo, Norway.

Class III—social sciences: Samuel S. Fels, Philadelphia; Guy Stanton Ford, Minneapolis; Felix Frankfurter, Washington; Philip C. Jessup, New York; Charles Seymour, New Haven; Harlan Fiske Stone, Washington; Charles Warren, Washington. *Foreign:* Eduard Beneš, formerly Prague; George Peabody Gooch, Cambridge, England.

Class IV—humanities: Van Wyck Brooks, Westport; Walter Johannes Damrosch, New York; Harry Miller Lydenberg, Scarsdale; Ralph Barton Perry, Cambridge; Theodore Leslie Shear, Princeton; Edgar Howard Sturtevant, New Haven; Lynn Thorndike, New York; Herbert Eustis Winlock, New York. *Foreign:* Martin P. Nilsson, Lund, Sweden; Sir Aurel Stein, Srinagar, Kashmir.

Officers reelected were: *President,* Dr. Roland S. Morris; *Vice-presidents,* Dr. Edwin G. Conklin, Dr. Robert A. Millikan and Dr. Cyrus Adler; *Secretaries,* John A. Miller and William E. Lingelbach; *Curator,* Albert P. Brubaker; *Treasurer,* Fidelity-Philadelphia Trust Company. New members elected to the council are *Class I,* Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute, Philadelphia; *Class II,* Dr. Albert F. Blakeslee, director of the department of genetics, Carnegie Institution of Washington, at Cold Spring Harbor, L. I.; *Class III,* Dr. Harold G. Moulton, president of the Brookings Institution, Washington, and *Class IV,* Dr. Waldo G. Leland, secretary of the American Council of Learned Societies.

HARVEY CUSHING'S SEVENTIETH BIRTHDAY

DR. HARVEY CUSHING'S seventieth birthday on April 8, to which brief notice was given in these columns two weeks ago, is an event in American medicine of more than passing significance. Without fear of contradiction the *New England Journal of Medicine* at the time of his birthday referred to Dr. Cushing as the greatest figure that America has produced in medicine. His importance lies, not only in the fact that he has created a new field of surgery, but in his having established a school of surgery with ideals and traditions that have influenced the course of medicine in every civilized country. No other American physician in the annals of our history—not even Welch—has attracted so large a group of foreign pupils, and the altogether spontaneous outpouring which came on April 8 from his pupils and admirers in every corner of the world bears outspoken testimony to his enormous influence.

It devolved upon the Harvey Cushing Society, which elected to hold its eighth annual meeting in New Haven (April 6 to 8), to arrange the birthday party. In view of Dr. Cushing's well-known abhorrence of pomp and circumstance, the society insisted upon having a small family party restricted to its membership, one invited guest for each member, and several guest speakers. The society's usual program of papers was read on Thursday and Friday, April 6 and 7; on Friday evening, Dr. J. F. Fulton gave an account of his trip by clipper to the southern Philippines in search of *Tarsius* monkeys, and on Saturday morning operations, clinics and experimental demonstrations were presented before the society. The birthday banquet took place on Saturday evening. Dr. Louise Eisenhardt, president of the society for 1939, was in the chair and opened the exercises by reading an amusing letter just received from President Roosevelt. The other speakers included: Dean Stanhope Bayne-Jones, of the Yale School of Medicine; Dr. W. W. Francis, protobibliothecary of the Osler Library and nephew of the late Sir William Osler; A. M. Muirhead, bibliographer and author of the life of Lady Osler, brought greetings from the British Empire and from the Osler Club of London; Dr. Olof Sjöqvist, of Stockholm, who presented a Swedish *festskrift* to Dr. Cushing; Dr. J. F. Fulton, who read extracts from among more than five hundred letters and telegrams received by Dr. Cushing during the day; Dr. W. J. German, who read two letters from among some hundred and twenty received from patients from whom Dr. Cushing had removed meningiomas of the brain, and finally, Dr. Arnold C. Klebs, of Nyon, Switzerland, who came from Europe for the banquet and returned immediately after it was over.

Dr. Louise Eisenhardt then presented the society's gift to Dr. Cushing, which consisted of a specially bound copy of an annotated bibliography of all Dr. Cushing's writings. The bibliography had been prepared by the society as a surprise. Dr. Cushing then responded to the various tributes. His loyal operating room orderly, Adolph, was present at a suitable moment to mop his brow as in the old days in the operating theater.

There were four printed volumes issued in connection with Dr. Cushing's birthday:

1. A *festskrift* from Scandinavian neurologists and neurosurgeons containing 25 papers—all but two in English—issued under the editorship of Professor Herbert Olivecrona of Stockholm as a supplementary volume of *Acta Chirurgica Scandinavica*, 1939, vol. 82, 99–363.

2. A special number of the *British Journal of Surgery* dedicated to Dr. Cushing, containing a detailed report by Mr. William Henderson of the end-results of all Dr. Cushing's operations for pituitary adenomas. The title is as follows: "The pituitary edenomata. A follow-up study of the surgical results in 338 cases (Dr. Harvey Cushing's series)." *British Journal of Surgery*, 1939, vol. 26, pp. 809–921.

3. A special number of the *Yale Journal of Biology and Medicine* containing all the papers read at the meeting and designated "The Cushing Anniversary Volume." It includes 26 papers.

4. An annotated bibliography of all Dr. Cushing's writings, issued by the Harvey Cushing Society. The volume was designed by Mr. Carl P. Rollins, printer, of Yale University, published by Mr. Charles C Thomas, who had issued four of Dr. Cushing's previous monographs, and printed by the George Banta Publishing Company. The title is as follows: "A Bibliography of the Writings of Harvey Cushing Prepared on the Occasion of His Seventieth Birthday, April 8, 1939," by The Harvey Cushing Society, Springfield, Ill., Charles C Thomas, 1939, xvi, 110 pp.

The speeches and extracts from letters and cables will presently be issued as a separate brochure by Mr. Charles C Thomas. J. F. F.

SCIENTIFIC NOTES AND NEWS

DR. E. D. MERRILL, director of the Arnold Arboretum and administrator of the Botanical Collections of Harvard University, has been awarded the Linnean Gold Medal, given annually by the Linnean Society of London "to an eminent biologist as an expression of the society's estimate of his services to science." He has also received through the State Department the gold medal of the Ministry of Agriculture of the French Republic and the corresponding diploma of the Société nationale d'acclimatation de France. These

were conferred "in appreciation of services to French horticulture" at a session of the society held at the Museum of Natural History, Paris, in March.

THE Clement Cleveland Medal for "Distinguished Service to Public Education on Cancer" was presented to Mlle. Eve Curie, daughter and biographer of the late Mme. Marie Curie, at a dinner held on April 18 in the Cosmopolitan Club, New York City. Dr. Francis Carter Wood presented the medal, which was established in 1937 by Mrs. Robert G. Mead in memory of her father, a pioneer of the movement to educate the public in the importance of early diagnosis and prompt treatment of cancer.

DR. ALEXIS CARREL, member of the Rockefeller Institute for Medical Research, was presented on April 13 with the Service Medal of the Rotary Club of New York, "in recognition of a life dedicated to the amelioration of human suffering."

THE Joseph A. Capps Prize in medical research of $400 of the Institute of Medicine of Chicago has been awarded for 1938 to Broda O. Barnes, who graduated from Rush Medical College in 1937, for his paper on "Observations on the Adreno-Genital Syndrome." The prize, founded by the late Dr. Edwin R. LeCount, is awarded annually for the most meritorious investigation in medicine completed by a graduate of a recognized medical school in Chicago within two years after the completion of an internship or of one year of laboratory work.

DR. DAVID SARNOFF, president of the Radio Corporation of America, was among those who received a scroll of honor on April 19 from the National Institute of Immigrant Welfare. The award is given to "distinguished citizens of foreign birth who have made significant contributions to American life."

THE Mittag-Leffler Institute Gold Medal of the Mathematical Institute at Stockholm has been awarded to M. Émile Picard, professor of mathematics in the University of Paris and permanent secretary of the Academy for Mathematical Sciences, Paris.

MAJOR R. LIGHTFOOT, director of the Geological Survey of Southern Rhodesia, has been elected president of the Geological Society of South Africa.

M. BERNARD LYOT, of the Meudon Observatory, has been elected a member of the Section of Astronomy of the Paris Academy of Sciences in succession to the late A. de La Baume Pluvinel.

COLUMBIA UNIVERSITY has conferred the title of professor emeritus in residence on Dr. Charles P. Berkey, geology; Dr. Marston T. Bogert, organic chemistry; Dr. Gary N. Calkins, protozoology; Dr. Bergen Davis, physics, and Dr. Frederick J. E. Woodbridge, philosophy. The title of professor emeritus has been conferred on Dr. Daniel D. Jackson, chemical engineering; Dr. Robert Lewis, otolaryngology; Dr. Herbert B. Wilcox, diseases of children; and Dr. Francis Carter Wood, director of the Institute of Cancer Research.

OVID WALLACE ESHBACH, of the New York office of the American Telephone and Telegraph Company, has been appointed dean of the new Institute of Technology at Northwestern University. He will take up the work at once. The institute will be established under a grant of $6,735,000 from the Walter P. Murphy Foundation of Chicago. It will open in the autumn term of 1940 and will include departments of chemical, civil, mechanical and electrical engineering. It will be conducted on the cooperative plan.

DR. MICHAEL J. ZIGLER has been promoted to a professorship of psychology and Margaret Parker to a professorship of geology and geography at Wellesley College.

DR. ROBERTS RUGH, instructor in zoology at Hunter College, has been appointed associate professor of biology in the Graduate School of New York University.

THE trustees of the Anatomical Journal Trust, the Minot Memorial Fund, have appointed Professor Philip E. Smith, of Columbia University, to be a trustee in place of the late Charles R. Stockard. The other trustees are Professors Bradley M. Patten, University of Michigan, and George W. Corner, University of Rochester. The latter will act as chairman.

DR. CARL J. WIGGERS, professor of physiology of Western Reserve University School of Medicine, has been awarded $4,100 from the John and Mary Markel Foundation. The grant is for a study of the nature of ventricular fibrillation by means of desensitizing the heart.

SIR WILLIAM BRAGG, president of the Royal Society and director of the Davy Faraday Laboratory of the Royal Institution of Great Britain, will speak at Bryn Mawr College on May 4. His subject will be "The Structure of Organic Crystals."

THE fourth Hughlings Jackson Memorial Lecture of the Montreal Neurological Institute was given on April 19 by Dr. Walter B. Cannon, George Higginson professor of physiology at Harvard University. The title of the lecture was "The Law of Denervation." Following the lecture a specially bound copy of the "Selected Writings of John Hughlings Jackson," edited by James Taylor, was presented to Dr. Cannon.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, on April 11 gave a lecture on "Cosmic Rays" before the Society of the Sigma Xi at the Kansas State College, Manhattan. The lecture

was a part of the initiation exercises at which twenty-six new members were received.

DR. CARL D. ANDERSON, associate professor of physics at the California Institute of Technology, addressed the Iowa State College Chapter of Sigma Xi on March 30. His subject was "Cosmic Rays and a New Elementary Particle of Matter."

PROFESSOR G. H. PARKER, of Harvard University, lectured on "Modern Views on the Action of the Nervous System" before the ninth annual Connecticut Valley Student Scientific Conference held at Williamstown, Mass., on April 15.

DR. EARNEST ALBERT HOOTON, professor of anthropology at Harvard University, gave in April a series of four lectures before the Wagner Free Institute of Science, Philadelphia, on "The Making and Mixing of Human Races."

THE seventh series of Thomas William Salmon Memorial Lectures was given by Dr. Edward A. Strecker, chairman of the department of psychiatry of the School of Medicine of the University of Pennsylvania, at the New York Academy of Medicine on April 14, 21 and 28. Dr. Strecker's general subject was "Beyond Clinical Frontiers." The individual titles of the lectures were: "The Massive Retreat from Reality"; "Crowd-Mindedness" and "Threat to Our Culture."

PROFESSOR ANTON J. CARLSON, of the Department of Physiology of the University of Chicago, made an address before the Academy of Medicine of Washington, D. C., on April 24, on "Science and the Common Life." He spoke before the Smith-Reed-Russell Society, honorary organization at the George Washington University School of Medicine, on the following day, when his address was entitled "Notes on Medical Education and Medical and Public Health Services in Russia and China."

THE fourth Leo Loeb lecture under the annual lectureship established by the Mu Chapter of the Phi Beta Pi medical fraternity was delivered on April 20 by Professor Soma Weiss, of the Harvard Medical School. The title of the lecture was "Vasomotor Reactions and Circulatory Collapse."

THE American Ophthalmological Society will celebrate its seventy-fifth anniversary on June 7. This is the first society in the United States to be devoted exclusively to ophthalmology.

THE annual Congress of the Society for British Entomology will be held in the Manchester Museum and the University of Manchester from July 15 to 17, under the presidency of Professor W. A. F. Balfour-Browne.

IT is stated in *Nature* that the thirty-seventh annual meeting of the South African Association for the Advancement of Science will be held in East London from July 3 to 8, under the presidency of Professor G. H. Stanley. The British Association Medal for 1938 will be awarded to Miss Jean Murray, of the Division of Plant Industry, Pretoria, for her paper entitled "An Investigation of the Inter-relationship of Vegetation, Soils and Termites." A symposium on "The Need for the Investigation and Conservation of Human Resources in South Africa" is being organized by Dr. E. G. Malherbe, director of the National Bureau of Education and Social Research, Pretoria. Further information can be obtained from the assistant general secretary, H. A. G. Jeffreys, P. O. Box 6894, Johannesburg.

THE sixth International Technical and Chemical Congress of Agricultural Industries will be held in Budapest from July 10 to 20 under the patronage of the Regent of the Kingdom of Hungary. Three divisions have been arranged—(1) general, scientific and industrial studies, with sections of biology, analytical methods and apparatus, agronomy and research in the creation of new agricultural industries; (2) specific industries, including sugar, fermentation, foods, tropical industries and substitutes, and (3) economic studies, legislation and international agreements.

APPLICATIONS for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, not later than May 15. Grants are made to assist research in the field of chemistry. On account of limited resources, grants to an individual are seldom made in excess of $300. The application should be accompanied by an account of the research to be undertaken, a statement of the sum requested and the manner in which the money is to be expended.

TWELVE fellowships in the medical sciences, including three renewals, for study in the United States and abroad during the year 1939–40, were awarded at the February meeting of the Medical Fellowship Board of the National Research Council, Washington, D. C., of which Dr. Francis G. Blake, Sterling professor of medicine at Yale University, is the chairman. A list of the successful candidates and institutions where they are to work follows: Philip P. Cohen (renewal), University of Sheffield, England; Thomas Harrison Davies (renewal), California Institute of Technology; Victor M. Emmel, Yale University Medical School; Alto E. Feller, the Harvard Medical School; Arden Howell, Duke University; Fremont Ellis Kelsey, University of Pittsburgh; Abe Ravin, the Harvard Medical School; Joseph Shack, the Johns Hopkins University; William M. Wallace, the Harvard Medical School; Wilfred W. Westerfeld (renewal), Eidgenössische Technische Hochschule, Zurich, Swit-

zerland; Richard Winzler, University of Stockholm; William Barry Wood, Jr., the Harvard Medical School.

THE University of Alabama Chapter of the Society of the Sigma Xi was installed on April 4. Dr. Edward Ellery, national secretary of Sigma Xi, gave an address on "The Urge to Know and Academic Freedom," at a special morning convocation. Dr. George A. Baitsell, national president, gave a lecture on "Uniformity in Nature" immediately after the banquet. During the formal installation exercises, the following were elected as officers of the new chapter: *President,* Dr. Emmett B. Carmichael, professor of physiological chemistry; *Vice-president,* Dr. J. D. Mancill, assistant professor of mathematics; *Secretary,* Dr. E. F. Richards, assistant professor of geology, and *Treasurer,* B. W. Gandrud, metallurgist, U. S. Bureau of Mines, Southern Experiment Station, Tuscaloosa.

THE Graduate Science Club of Stanford University was installed as a chapter of Gamma Alpha Graduate Scientific Fraternity on April 14 at the Stanford Union. Dr. Carleton F. Scofield, the national president of Gamma Alpha, was the installing officer. In the evening there was an installation banquet at which many distinguished guests were present.

SIR FREDERICK BANTING has been appointed by the Associate Commission on Medical Research, which is financed by the National Research Council of Canada, to investigate medical research facilities in all parts of Canada. He has completed a survey of the maritime provinces and is expected to report to the associate commission the results of his work this year. The survey was made possible by the aid of the Canadian Medical Association and the Royal College of Physicians and Surgeons of Canada. During the survey of western Canada, Sir Frederick will visit the University of Manitoba, the University of Saskatchewan, the University of Alberta and the University of British Columbia. On his return to eastern Canada, he will consult with Calgary and Regina hospitals and Brandon College authorities.

IN compliance with the requirements of a gift under the will of the late Francis Amory, of Beverly, Massachusetts, the American Academy of Arts and Sciences announces the offer of a septennial prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs, to be known as the Francis Amory Septennial Prize. The prize may be awarded to any individual or individuals for work of "extraordinary or exceptional merit" in this field. In case there is work of a quality to warrant it, the first award, which will exceed ten thousand dollars, will be made in 1940. It may be given in one or more awards. Requests for further information should be addressed to the Amory Fund Committee, care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Massachusetts.

THE Dazian Foundation for Medical Research recently began to function. In accordance with the will of Henry Dazian, the foundation is prepared to award fellowships to individuals holding the degree of doctor of medicine, for the purpose of post-graduate study and research, and grants to laboratories, hospitals and similar institutions, for research in medicine. Applications and inquiries should be directed to the Secretary, 180 East 64th Street, New York, N. Y. Members of the board of directors are: Alexis Carrel, William W. Cohen, treasurer; Philip Finkle, secretary; Emil Friedlander, assistant secretary and treasurer; Emanuel Libman, president; Harrison, S. Martland, Alfred L. Rose, Israel Strauss, vice-president, and Harold Williams.

DISCUSSION

ON THE PATH OF THE FIREFLY WHILE PERIODICALLY FLASHING[1]

A GREAT deal has been written on the life history of the fire-fly, and many, including physicists and chemists, have speculated on the efficient light that these small insects can turn on and off at will. It is not the writer's intention to say anything regarding the former, since he is not a zoologist, or anything regarding the chemical and physical aspects in the production of the light, but he does wish to call attention to one of the firefly's instinctive qualities, namely, to its path in flight while periodically flashing. A fairly complete search through the literature for discussions on this point has been made without much success.

[1] Read before the Zoological Section of the Illinois State Academy of Science, May, 1938, and to be printed in the forthcoming *Transactions* of the academy.

The writer was reared on a farm in the "Big Woods" of northwestern Ohio at a time when nature there was still in its unspoiled state, for three fourths of the area was forest. He remembers as a boy a field of about ten acres, recently cleared, lying along side of the road and adjacent to his father's place. We often drove along this road at dusk and with wonderment observed the myriads of fireflies moving about over this newly cleared, but not yet broken, field. The soil conditions, the humidity, the decaying stumps and new undergrowth must have been favorable for their existence and propagation. It was in this field that the writer first observed the actual path that the firefly traces in flight while flashing periodically. He has observed this same characteristic path down through the years, and only last summer checked it again. It

should be stated that numerous persons have been interviewed, including zoologists, chemists, physicists, physiologists and psychologists, and he has the first one yet to find who definitely stated having noticed the recurrent irregularities in the flight of the firefly at the time of flashing.

A brief description and discussion follow: The firefly on its twilight excursions flies for the most part in a horizontal direction. Take a windstill evening. A trace of its path viewed horizontally and from the side is shown in Fig. 1. The portions *a, b* and *c* represent

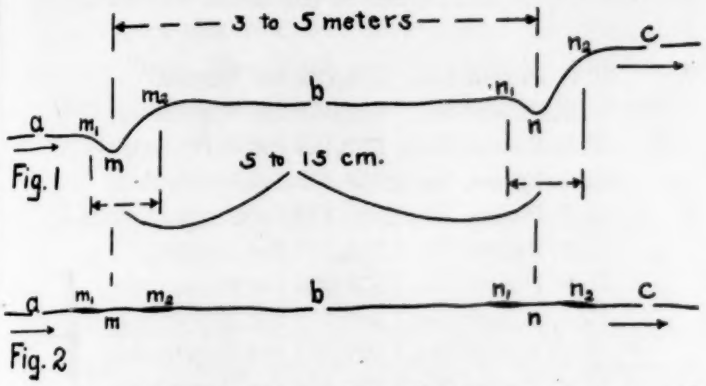

FIG. 1. Side elevation. Two flashes, m_1 m m_2, and n_1 n n_2, are shown. FIG. 2. Top plan, looking down. Wavering shown by thickened line.

the more or less undulating stretches of the flight of the fly, while m_1 m m_2 the path during a "flash" and n_1 n n_2 the path during the next following flash. As viewed from the side the fly on approaching m_1 slows down appreciably (seeming to waver slightly as though in an effort to stop) but maintains its flying level. The light is then turned on, and simultaneously the firefly drops visibly from its horizontal flight, but acceleration at once ensues, the downward duck is quickly arrested, followed by an upward spurt, as shown by the trace m m_2 in the figure. On reaching m_2, at a distance of from 5 to 15 cm from the beginning of the flash, the light is suppressed and simultaneously the flight is again slowed down. The fly seems to waver, as in an effort to regain its equilibrium, before continuing its more or less undulatory flight along *b*, reaching n_1, When the luminous path cycle is repeated.

Looking down from above, Fig. 2, the path discloses no outstanding characteristics. The direction of flight is pretty much straight ahead, but on close observation there may be at times signs of wavering at the points m_1 and m_2 and also at n_1 and n_2, referred to above and shown in Fig. 2 by the thick portions of the line. Observations from above reveal the accelerations in flight, both positive and negative, over the flash period. These observations are not easy to make, as one can well imagine.

Speculating on the evidence revealed by the foregoing, it seems that the system (the firefly) may be thought of as containing stored energy under control of the insect for both maintaining flight and producing flashes of light. The fly now contemplates a flash as it approaches, say, m_1. On turning on the light (drawing energy from the common source) the attendant "overload" causes the mechanism necessary for sustained flight to slow down and the fly drops slightly. Simultaneously extra stores of energy are tapped, the flight mechanism responds, the illumination brightens and the insect speeds upward, in its endeavor to overcome the falling tendency, and reaches the point m_2, having thus described the smooth path m_1 m m_2. At m_2 the energy for the production of the light is shut off, and with it, doubtless, some that was needed in maintaining flight. The flight mechanism again slows down, the fly may waver as though to regain its balance (Fig. 2), and then starts off at reduced speed over the routine flight between flashes, while energy for the next flash is generated (chemically or otherwise) en route. That considerable energy is expended in the production of the flash and must be renewed (between flashes) is evidenced by the fact that if the fly is caused to emit light continuously its brightness dims perceptibly with time.

The above are the writer's observations, extending over a long period. Fig. 1 depicts the path quite accurately. Have other observers noticed similar persistent irregularities?

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PATENTS FOR ACTS OF NATURE

Now that Senator Joseph G. O'Mahoney and his colleagues of the Temporary National Economic Committee have apparently concluded their series of snapshot exposures of the iniquities of patent-owners who pool their patents to create wicked monopolies and who exercise "dog in the manger" control of inventions by "pigeonholing" the patents upon them, let them investigate a real abuse of our patent system—patents for true chemical compounds—surely the most preposterous patent monopolies that have ever been foisted upon the public with, alas, the sanctions of some of the courts.

All patent monopolies in this country derive from that provision of the Constitution which reads:

> Congress shall have Power. . . . To Promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

As early as 1790, Congress, pursuant to the grant of this express power, enacted legislation authorizing the granting of patents for arts, manufactures, engines, machines and devices, and improvements upon such subject-matters, but this legislation soon proved to be far from satisfactory. So, three years later, Congress

enacted the superseding Patent Act of 1793, which authorized the granting of patents for arts, machines, manufactures and compositions of matter, and improvements upon such subject-matters, and thereby established those categories of patentable inventions which have persisted unchanged and unreconsidered in our statutory patent laws for the past one hundred and forty-six years. Now while true chemical compounds indubitably are compositions of matter, they constitute a very special kind of compositions of matter, for they are unique molecularly-homogeneous substances of invariant compositions and fixed properties, unalterable by man; but in 1793, not even the most astute chemists (let alone Congressmen) then living could be certain of these facts, because they were not then known, for they were first established experimentally during the years 1801–09 by Proust in his controversy with Berthollet.

By 1841 or earlier, the courts had wisely decided that the word "Discoveries" in the Constitutional provision means merely "inventions"; and hence, only "inventions" are patentable. Now an "invention" is a specifically human affair: it is necessarily a creating or contriving by man—some thing or some action or series of actions performable upon materials that man can, and does, make or perform—in short, a purely human accomplishment: it is, above all, *not* something that nature, and only nature, can create. In other words, the "inventive-content" of any alleged "invention" is, and can never exceed, the contributions, mental and physical, made by man in the sum-total of the phenomena connoted by the alleged "invention"; for, to the "inventor" are likewise applicable those discerning words wherewith Anatole France characterized the "scientist" when he wrote:

> Le savant multiplie les rapports de l'homme avec la nature, mais lui est impossible de modificier rien la caractère essentiel de ces rapports.

The U. S. Supreme Court heavily underscored this conception of "inventions" in 1852 by intimating that "principles of nature", including properties of matter such as the property of plasticity possessed by lead, are definitely unpatentable. Surely there can be no disagreement with these views, inasmuch as it would be most absurd for the Federal government to grant patents for "principles of nature", *i.e.*, phenomena of nature which man had stumbled upon and had not, nor could have, created or contrived, such as the inherent properties of substances. And so consistently have the courts subscribed to this doctrine of the unpatentability of properties of matter that they have refused to sustain patents for the property of ductility possessed by pure tungsten, pure uranium and pure vanadium.

What, then, is most astounding is the fact that the U. S. Patent Office has granted, and certain of the lower Federal courts have sustained, patents for true chemical compounds themselves. Thus, in 1902, the U. S. Circuit Court of Appeals for the Third Federal Circuit sustained U. S. Patent No. 400,086 for acetylphenetidine (phenacetin), and, in 1910, the U. S. Circuit Court of Appeals for the Seventh Federal Circuit sustained U. S. Patent No. 644,077 for acetylsalicylic acid (aspirin). As precedential cases, these two decisions unquestionably and most unfortunately have had the effect of apparently warranting the validities of the enormous number of patents for true chemical compounds, as such, some of the better known of which are:

U. S. Patent No. 782,739 for Veronal
U. S. Patent No. 812,554 for Novocaine
U. S. Patent No. 986,148 for Salvarsan
U. S. Patent No. 1,025,872 for Luminal
U. S. Patent No. 1,280,119 for Tryparsamide
U. S. Patent No. 1,514,573 for Amytal
U. S. Patent No. 1,533,003 for Mercurochrome
U. S. Patent No. 1,649,670 for Hexylresorcinol
U. S. Patent No. 1,825,623 for Nupercaine
U. S. Patent No. 1,921,424 for Benzedrine

But *are* these decisions sound? *Of course not!* If there is one thing on this earth that man can not "invent", it is a true chemical compound, because every true chemical compound, as such, is nothing more or less than an ensemble of unpatentable properties of matter, created and quantitatively embodied in tangible substance solely by nature. You can put together mutually reactive substances, and that "putting together" may well constitute a patentable process, but what you get by, and out of, the interactions of the juxtaposed substances depends wholly upon the volition of nature. Nature, and nature alone, fixes the structure, the composition and the inherent properties of every true chemical compound that is producible by processes devised by man, and neither you or I nor any one else can alter any one of them. Obviously then, no true chemical compound, as such, can be an "invention".

When Germany enacted her statutory patent laws in 1877, just seven years *after* the last not-too-casual overhauling of our statutory patent laws by Congress, she accorded full recognition to the fact that true chemical compounds, as such, can not be "inventions" by extending to them, not intrinsic patent protection, but patent protection merely to the extents that they were products of patentable processes. Hence, in Germany today, owners of patents for non-equivalent processes for producing the same true chemical compound can, each and every one, produce that true chemical compound without let or hindrance by the others. In 1919, England adopted in her statutory patent laws precisely the same attitude toward true chemical compounds. But in this country, under the aforemen-

tioned decisions of the lower Federal courts, the man who first produces a novel true chemical compound can acquire by a patent so absolute a monopoly upon that true chemical compound that for seventeen years he can prevent any one from producing it by any process whatsoever, including all processes which are entirely unlike his own process. Surely nothing could be more irrational than the fact that upon producers of true chemical compounds, including medicinals and pharmaceuticals such as those listed above, were, and are, bestowed the tightest patent monopolies on the face of the earth, founded, mind you, upon subject-matters which can not be "inventions" of man, but which are "inventions" of nature alone! And since such absolute patent monopolies undoubtedly discourage the developments of novel processes for the productions of patented true chemical compounds, they can hardly be said "To Promote the Progress of Science and Useful Arts."

Fortunately, the U. S. Supreme Court has never explicitly affirmed any one of these egregious decisions of the lower Federal courts, nor has it ever categorically declared true chemical compounds, as such, to be patentable, so that a single decision of that tribunal will suffice to dispose of these "earth and a slice of Heaven" patent monopolies. But an amendment of our statutory patent laws, expressly excluding from intrinsic patent protection all true chemical compounds, would accomplish the same result just as effectually and more expeditiously.

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SPACE PERCEPTION BY RADIO

MOST people who have bought an improved radio junk their old one. That is not always wise, as will be shown. First find out whether your old radio amplifies better the low or the high pitches prevailing in music. Then adjust your new radio, which often permits it, so that the other pitches are favored by its amplification. Now, if you have a very large room, put one radio in one corner and the other in the diagonal corner, and seat yourself near the middle. If you have only small rooms, choose two with a connecting door open, place your radios as far apart as possible and seat yourself near the door in the larger of the two rooms. A little experimenting may be called for. You will more or less readily observe a strange effect. Close your eyes or simply forget what you actually see with them. It seems that you have before you the orchestra with the musicians so seated that the highest pitched instruments are on one side of the stage, the lowest pitched on the other side, and the middle instruments ranged between accordingly.

If it is a mixed chorus you are listening to, the female singers seem to be on one side of the stage, the male singers on the other side. Or if it is a duet of a soprano and a basso of the Metropolitan Opera, you seem to be located between the woman and the man. In some cases, though, the peculiar voice quality of the basso singer may diminish the strength of this spatial illusion by "splitting," so to speak, the basso's voice into a lower and an upper component. It goes without saying that you can have the effect only if you have two fairly good ears. If you are deaf or hard of hearing on one of your ears, you will try in vain.

The whole effect would be a very small *esthetic* addition, if any, to what you can get with a single radio, although in any case it would be interesting enough. But there is something else to be mentioned. As soon as you begin to differently *localize* the higher and lower sounds, you notice that the ease with which you *analyze* the compound sound is enhanced, the keeping apart of the components of any chord in your musical apprehension is a matter of less effort to your attention. When the tones say to you, "I am here and I am there" you become more readily aware of their separate existence. Now, whoever knows anything about the psychology of music knows that the ability to analyze, to overcome the fusion to which the simultaneous tones are subject in the untrained listener, is one of the greatest assets for the appreciation of our modern highly complex music. The method above described is therefore a distinct aid for getting the maximum of esthetic appreciation. If you have two good ears, why not utilize fully the possession of both?

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MICROBIOLOGY OF COAL

A STUDY of the biological decomposition of coal has been under investigation in the Departments of Fuel Technology and Bacteriology of the Pennsylvania State College for several months to determine the types of microorganisms that can decompose coal, to study the changes occurring in solutions containing humic acids prepared from bituminous coal and to examine the technical and economic aspects of such changes.

While various investigators have established the presence of microorganisms in coal, an appreciable consumption of coal substance by microbial activity has not previously been recorded in the scientific literature.

For the present experiments coal solutions proved to be an excellent substrate for cultivating bacteria. These solutions were prepared from the alkali-soluble "humic acids" resulting from the oxidation of bituminous coal. The basic substrate for the biological experiments was a 2 per cent. humic acid solution. Microorganisms of the order of true bacteria, fungi and actinomyces were found to grow on liquid and solid

humic acids media. The organisms utilized the coal substance for their food and energy requirements up to the point where almost the entire carbonaceous material was consumed. By bacterial action over a period of at least six weeks, the originally dark-brown solutions became colorless, indicating that the humic acids were completely destroyed.

A preliminary chemical investigation has shown that the breakdown of the coal substance does not yield volatile compounds, such as methanol or acetic acid but gives rise to non-volatile acids, which are now under investigation.

It is believed that the products formed by the activities of microorganisms on coal solutions may prove of economic value. In addition, a knowledge of the type and the mechanism of metabolism of such microorganisms will assist in a better understanding of the decomposition of humic acids in soils.

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SOCIETIES AND MEETINGS

THE FIRST SOUTH AMERICAN BOTANICAL CONGRESS

THE first South American Botanical Congress held its meetings at Rio de Janeiro, Brazil, during the week from October 12 to 19, 1938. The congress was the result of efforts made by some of the leading botanists of South America to bring about such a gathering in order that a definite program of cooperation in botanical research could be initiated for the several South American nations and colonies.

Although the congress was specifically for South American botanists, other nations were invited to send botanical representatives, and Cuba, England, The Netherlands, Germany and the United States were represented. Chile, Peru, Paraguay and British and French Guiana were not represented by botanical delegates, but were represented at the general meetings by their embassies.

The greater part of four days was occupied in the reading and discussion of well over a hundred technical papers on various botanical and agricultural subjects. The papers given were about equally divided in the following fields of research: Systematic Botany, Microbiology, Morphology, Physiology, Genetics, Phytogeography and Applied Botany. Since the time was short and the papers numerous, the various fields of work were discussed in concurrently running sections and the delegates attended the sections which dealt with their particular field.

Two days of the congress were devoted to trips out of the city in order that visiting delegates could see some of the distinctive features in the nearby country. One of the trips was to the beautiful resort area about the town of Petropolis, which lies well up in the mountains some three hours' drive by car on an excellent highway from Rio de Janeiro. Here the delegates caught glimpses of virgin forest and made a highly interesting visit to a large private display of orchids. The officials of the town of Petropolis were hosts at a luncheon for the delegates. The other trip was a more extensive journey by rail to view the "restinga" vegetation of the seacoast.

Dr. P. Campos Porto, director of the Biological Institute and Botanic Garden at Rio de Janeiro and also president of the Committee of Organization for the congress, was host at a garden party for the delegates. The setting was of exquisite beauty, in the Botanic Gardens, with Royal palms and mountains for background and countless orchids blooming on all sides. Leading Brazilian artists contributed to the entertainment with folk dances and songs as well as classical music.

Two plenary sessions of the congress were held, during which several important resolutions were approved for recommendation to the respective governments. The following, of general interest, may be mentioned here:

To establish regional botanic gardens. Each country to choose areas within its limits to set up arboreta or botanic gardens where the representative flora of the region may be studied. These botanic gardens will form a South American System for exchange of information between the various regions of South America.

To establish a South American Botanical Bureau. Each country will establish a central bureau, which will be charged with the task of bringing together botanical information pertinent to that country. It is intended that the bureaus in each country will eventually become federated for the whole of South America and that eventually there will be established a central bureau for the continent.

To supervise and regulate exploration. Each country shall recommend that its government promulgate regulations so that such exploration can not take place without the previous knowledge and permission of the government. Duplicates of all collections shall be left in the country and unique or rare collections shall have their export forbidden.

At the opening meeting permanent officers were elected for the years 1939 to 1942. They are as follows: *President,* Dr. Alberto Castellanos, Museum of Natural History, Buenos Aires, Argentina; *Vice-president,* Dr. Fernando Rosa Mato, Museum of Natural

History, Montevideo, Uruguay; *Secretary-General,* Dr. Fernando Silveira, Institute of Education, Rio de Janeiro, Brazil. It was proposed by the delegation from Argentina that the Second South American Botanical Congress be held at the Institute Miguel Lillo at Tucuman, Argentina, in 1942. This was unanimously approved.

Brazil, famous for its generous hospitality, surpassed even this reputation as host to the delegates of the congress, and congratulations should be extended to Dr. Campos Porto and the Committee of Organization for a well-planned and well-executed program.

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SPECIAL ARTICLES

SEX MECHANISM IN POLYPLOIDS OF MELANDRIUM[1]

LAST spring a series of experiments designed to determine the effect of polyploidy upon sex in various dioecious plants was undertaken. A preliminary report on this investigation was given in December.[2] This present paper is a summary of work on colchicine-induced polyploids of a white-flowered race of *Melandrium dioicum.*

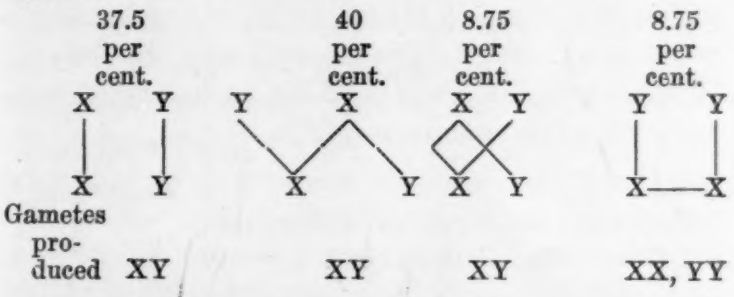
Fifteen out of 19 seed-treated plants examined proved to be entirely or partly 4n (8 XXYY males and 7 XXXX females). These plants were intercrossed and a second generation of over 100 3*n* and 4*n* plants was grown. There is enough difference in size between the sex chromosomes and autosomes and between the X and Y to determine the chromosomal constitution of a plant by cytological methods. The following is a tabulation of sex and chromosome constitution in second generation plants:

Type	Chromosomal constitution*	Number of plants and sex
2n (control)	2A + XX	17 ♀
	2A + XY	20 ♂
3n	3A + XXX	1 ♀
	3A + XXY	4 ♂; 1 ± ☿
4n − 1	4A + XXX	1 ♀
	4A + XXY	1 ♂
4n	4A + XXXX	3 ♀
	4A + XXXY	65 ♂; 3 ± ☿
	4A + XXYY	2 ♂
4n + 1	4A + XXXXY	1 ☿
	4A + XXXYY	3 ♂

*Irregularities in number of autosomes have been observed in plants in this table but for simplicity have not been indicated in the tabulation.

Among the 2n plants there are 20 males to 17 females. The preponderance of males among the 4n plants (67 to 3) is due to the fact that the XXXY individuals are very numerous, as Muller[3] and Westergaard[4] have predicted, and because XXXY plants are male. (Three XXXY male plants occasionally bear hermaphroditic (☿) blossoms; the 65 other plants of this genotype are vigorous, fertile males.)

Peculiar conjugation and segregation of the sex chromosomes is responsible for the large number of XXXY plants. The following types of association have been observed at MI in 80 P.M.C. of 2 of our XXYY males, in addition to 5 per cent. of infrequent types:



Ninety per cent. or more of the gametes produced by the original 4n males (XXYY), therefore, should be XY, and when these unite with the XX gametes from the female, the excess of XXXY individuals should result. Westergaard[4] has observed the X − X and Y − Y conjugation to be the most frequent type; he has not reported quadrivalent association.

In a state of nature the excess of the XXXY males would likely lead to their fertilizing a large majority of the 4n females. Since the XXXY males are completely fertile and produce XX and XY gametes, such hybridization should give rise to a population of equal numbers of 4n females of the constitution XXXX and of 4n males of the constitution XXXY (aside from occasional males with a few hermaphroditic flowers). Thus a new 4n race with approximate numerical equality of males and females should be possible. The conclusions of Muller[3] and Dobzhansky[5] that doubling of chromosomes could not be a factor in evolution of dioecious forms therefore appears unfounded.

In the plants with three sex chromosomes of one size and the fourth of a different size, the 3 similar chromosomes must be X, for it is impossible to obtain an

[1] This investigation has been supported in part by a grant from the Carnegie Corporation to the Carnegie Institution of Washington.

[2] H. E. Warmke and A. F. Blakeslee, *Genetics,* 24: 88, 1939.

[3] H. J. Muller, *Amer. Nat.,* 59: 346, 1925.

[4] M. Westergaard, *Nature,* 142: 917, 1938.

[5] T. Dobzhansky, "Genetics and the Origin of Species," Columbia Univ. Press, pp. 219, 1937.

XYYY individual from the cross XXXX by XXYY. It is thus possible in this material to measure the sex chromosomes *within a single cell* and determine accurately whether X or Y is the larger. In all our XXXY plants, the three similar chromosomes are small, and the single remaining one is large. Our findings agree, therefore, with those of Blackburn,[6] that the Y is the larger member of the sex pair, and disagree with the observations of Winge,[7] Meurman,[8] Breslawetz,[9] and Westergaard,[4] who report the X to be the larger. It is possible, of course, that our material may have a different chromosome constitution from the material investigated by these latter workers.

The plants 4A + XXXY (male) and 4A + XXX (female) differ genetically only in the absence of a Y chromosome in the latter. We may therefore conclude that the Y chromosome carries male-determining elements, contrary to the situation in *Drosophila*[10] and *Rumex*,[11] where the Y chromosome has been shown to play no role in primary sex determination. In the 3A + XXY and 4A + XXXY types, one Y is usually sufficient to outweigh the 2X or 3X chromosomes and to produce maleness. One Y apparently can not completely outweigh 4 X's in the XXXXY individual, however, and a hermaphrodite results.

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BROAD PROTECTIVE ACTION OF RABBIT ANTIPNEUMOCOCCUS SERUM IN RATS

FOLLOWING the work of Tillett (1927), who showed non-type-specific pneumococcus active immunity in rabbits, increasing attention has been paid to this problem, notably by Bailey (1931–1933), Day (1935), Harley (1935) and Dubos (1938).

During the past year we have prepared various type-specific antipneumococcus sera in rabbits, as Goodner and his associates have described. We have also used, in addition to the S forms, an R form known as DRI, as well as certain Forssman and other control antigens.

In view of the possible value of heterophile antibodies in rabbit antipneumococcus serum, it appeared advantageous to use white rats as test animals for the determination of the protective efficacy of the various sera.[1]

Passive protection tests were conducted by injecting suitable dilutions of antiserum and culture together intraperitoneally into white rats of from 90 to 100 grams weight. Varying doses of serum were used, each serum dose being tested against a series of chilled decimal dilutions of broth culture which had been incubated for six hours.

While more complete details will appear in a later report, certain preliminary observations should be reported. They are:

(1) Combined horse and rabbit antipneumococcus serum is not as effective as rabbit serum alone, even though the combined serum contains as many as five to ten times the heterophile antibody titer of the rabbit serum.

(2) Type specific rabbit sera show considerable heterologous protection—notably types II and V.

(3) Rabbit serum prepared from a rough variant of a type I strain—DRI—gives marked protection against at least seven types of pneumococci.

TABLE 1

PNEUMOCOCCUS RAT PROTECTION TESTS

Pneumococcus culture (cc.)	DRI rabbit antipneumococcus serum B–4651 against pneumococcus types: I				II				V				VIA				VII				VIII				XIV			
	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control
10^{-1} ..	S	S	D	D	S	D	D	D	S	D	D	D	D	D	D	D	D	D	D	D	S	D	D	D	D	D	D	D
10^{-2} ..	S	S	S	D	S	D	D	D	S	D	D	D	S	D	D	D	S	D	D	D	S	D	D	D	S	D	D	D
10^{-3} ..	S	S	S	D	S	S	D	D	S	S	D	D	S	S	D	D	S	D	D	D	S	D	S	D	S	S	D	D
10^{-4} ..	S	S	S	D	S	S	D	D	S	S	D	D	S	S	D	D	S	S	D	D	S	D	S	D	S	S	D	D
10^{-5} ..	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D	S	S	D	D	S	S	S	D	S	S	S	D
10^{-6} ..	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D
10^{-7} ..	–	–	–	S	–	–	–	S	–	–	–	D	S	S	D	D	S	S	D	D	–	–	–	S	S	S	S	D
10^{-8} ..	–	–	–	–	–	–	–	–	–	–	–	D	–	–	–	S	S	S	S	D	–	–	–	–	S	S	S	D

S = survival; D = dead; – = not tested.

[6] K. B. Blackburn, *Br. Jour. Exp. Biol.*, 1: 413, 1924.
[7] Ö. Winge, *C.R. Trav. Lab. Carlsberg*, 15, Nr. 5, 1923.
[8] O. Meurman, *Soc. Sci. Fennica Comment. Biol.*, 2, Nr. 3, 1925.
[9] L. Breslawetz, *Planta*, 7: 444, 1929.
[10] C. B. Bridges, *Amer. Nat.*, 56: 51, 1922.
[11] T. Ono, *Sci. Rep. Tohoku Imp. Univ.*, 10: 41, 1935.

[1] We are indebted to Dr. J. Bronfenbrenner, Washington University School of Medicine, St. Louis, for the suggestion that white rats are more appropriate test animals for antibody of rabbit origin than rabbits, as used in our former experiments.

Table 1 shows the results of pneumococcus rat protection tests with DRI rabbit antiserum B-4651 against culture types I, II, V, VIA, VII, VIII and XIV. It is observed that the DRI antiserum gives marked cross-immunity against all the types of pneumococci used.

It appears that rat protection tests show wider non-type-specific action of rabbit antipneumococcus serum than do mouse protection tests. Proper selection of culture as antigen contributes to the preparation of broad coverage rabbit antiserum. Just as heterophile antibodies can not be produced by the immunization of horses, it likewise appears that other antigenic components of the pneumococcus engender better response in the rabbit than in the horse. While heterophile antigen and antibody play a part in selection of culture and production of antiserum, it is evident that other factors likewise are of importance. More appropriate terms for use in discussing the broad coverage antipneumococcus serum may well be "somatic antigen" and "somatic antibodies."

On the basis of the results obtained in rat protection tests with DRI serum, the possibility of the development of a breed coverage antipneumococcus serum sufficiently high in "somatic" (species specific) antibodies to be of therapeutic value is indicated.

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THE AVAILABILITY OF MANGANESE IN AVIAN DIGESTION

THE perosis-aggravating action of certain calcium and phosphorus salts has long been known, but no explanation for this action has been advanced. The great contrast between the efficient utilization of manganese injected peritoneally[1] and the inefficient utilization of the manganese in the diet, particularly in the presence of high levels of calcium and phosphorus,[2] suggested that in the latter case the manganese may be rendered unavailable due to reactions within the intestinal tract. The fact that tri-calcium phosphate is dissolved in the upper part of the digestive tract, and is reprecipitated in the lower part, suggested that such an action might be responsible for rendering manganese unavailable through either adsorption or chemical combination.

This hypothesis was tested *in vitro* by precipitating calcium phosphate from solutions containing calcium, phosphate and manganous ions in known amounts approximating the concentrations previously used in producing perosis in this laboratory. Analyses of the precipitate, filtrate and washings showed that the manganese was carried down quantitatively by the calcium phosphate precipitate.

These results were substantiated by *in vivo* experiments. Dialysis of the contents of the digestive tracts of White Leghorn pullets showed that manganese in the digestive tract, in the excreta and even in the ration is rendered markedly less diffusible by the addition of excessive steamed bone meal to the diet. It has also been observed in this laboratory that as little as 0.17 per cent. of ferric citrate added to the basal diet caused an increase in the severity of perosis. It was observed *in vitro* that ferric chloride solution, when boiled with a known concentration of manganous ions present, allowed to pass through the colloidal state and precipitated by neutralizing with sodium hydroxide, removed the manganese quantitatively from solution.

It therefore appears that the perosis-producing action of calcium phosphate and of ferric citrate is due at least in a large part to the removal of manganese from solution in the intestinal tract, either by adsorption or chemical combination. This would also explain the perosis-aggravating action of calcium carbonate, since the presence of this compound in excess favors the formation of tri-calcium phosphate in the digestive tract. On the other hand, phosphoric acid and its monosodium and disodium salts, when added to a diet relatively low in calcium, would not tend to form tri-calcium phosphate. Consequently, the addition of these compounds to the diet should not increase the severity of perosis, and such has been shown to be the case.[3,4]

It would seem possible that the interference of calcium salts with iron assimilation,[5] the greater requirement for iodine on a high-calcium diet and other similar instances might prove to be explainable on a like basis.

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MOVEMENT OF RADIOPHOSPHORUS IN BEAN SEEDLINGS[1]

BEAN seedlings (var. Red Mexican) were allowed to

[1] M. Lyons, W. M. Insko and J. H. Martin, *Poultry Science*, 17: 12, 1938; C. D. Caskey and L. C. Norris, *ibid.*, 17: 433, 1938; A. C. Wiese, B. C. Johnson, C. A. Elvehjem and E. B. Hart, SCIENCE, 88: 383, 1938.

[2] C. D. Caskey and L. C. Norris, *Poultry Science*, 17: 433, 1938; A. C. Wiese, C. A. Elvehjem and E. B. Hart, *ibid.*, 18: 33, 1938.

[3] Unpublished results, Colorado Agricultural Experiment Station.

[4] P. J. Schaible, J. M. Moore and R. A. Conolly, *Poultry Science*, 12: 324, 1933.

[5] S. W. Kletzien, *Jour. of Nutrition*, 15: 6, 1938.

[1] The writer wishes to express his appreciation to the National Research Council for aid in this project, also to Drs. E. O. Lawrence and J. H. Lawrence for the sample of radiophosphorus.

grow for varying lengths of time in a nutrient solution containing radiophosphorus (obtained through the courtesy of E. O. Lawrence) at the approximate concentration of 3.5 uc/cc. The bean seedlings had been previously grown without phosphorus, and at the time of use gave slight evidence of phosphorus deficiency by the dark color of the leaves. When placed in the solution containing radiophosphorus, the opposite leaves and the first alternate leaf appeared fully mature. The third alternate leaf was just unfolding.

The plants were placed, one after another, in the radiophosphorus containing nutrient solution. After the required interval of time the plant was removed, the roots carefully washed and the plant dissected and placed in the drying oven. When thoroughly dry the parts were ground to a fine powder and samples weighed for analysis. Each sample was placed in a thin Cellophane (du Pont #3100) cone, which was mounted immediately above the sensitive window of a Geiger counter. The Neher-Harper "High Speed Geiger-Counter Circuit"[2] in connection with "A Direct-Reading Counting Rate Meter for Random Pulses"[3] was used for detecting radiophosphorus in the plant samples. The results are shown in Table I.

TABLE I

DISTRIBUTION OF RADIOPHOSPHORUS IN VARIOUS PARTS OF BEAN SEEDLINGS

Length of time in solution	48 hrs.	24 hrs.	2½ hrs.
Mg. of sample used	4 mg.	10 mg.	10 mg.
	Counts/min.	Counts/min.	Counts/min.
Roots	2,364*	1,968	1,092
Hypocotyl	804	744	228
Stem		468	
Opposite leaves	1,104	504	144
First alternate leaf	1,934	888	204
Second alternate leaf	2,124	1,380	240
Third alternate leaf	2,364*		216
Background	36		

* Counter reached end of scale. True value slightly higher.

It was possible, under conditions of the experiment, to detect radiophosphorus in the uninjured plant by moving the shielded counter tube over the leaves and stem. In order to get away from stray radiation, the following technique was adopted.

Discs of fresh leaf tissue were cut from a plant which had been in the radiophosphorus containing nutrient solution for two and one half hours. They were held over the sensitive window of the Geiger counter. A lead shield with a circular hole 7.5 mm in diameter was used to determine the area of leaf tissue exposed to the sensitive window of the counter tube. The results are shown in Table II.

[2] H. V. Neher and W. W. Harper, *Phys. Rev.*, 49: 940, 1936.

[3] N. S. Gingrich, R. D. Evans and H. E. Edgerton, *R. S. I.*, 7: 450, 1936.

TABLE II

DISTRIBUTION OF RADIOPHOSPHORUS IN FRESH LEAF TISSUE

	Counts/min.	Distance from base of hypocotyl
Opposite leaves	10	18.0 cm
First alternate leaf,		
tip leaflet	46	25.5 "
lateral leaflet	54	23.4 "
Second alternate leaf,		
tip leaflet	20	22.3 "
lateral leaflet	62	20.6 "
Third alternate leaf,		
tip leaflet	38	18.7 "
lateral leaflet	33	17.8 "
Background	36	

The results indicate that phosphorus may be absorbed by the apparently uninjured roots of phosphorus-deficient plants and transported at a rate exceeding 10 cm/hr. From the distribution of radiophosphorus in the plant it appears that movement in the aerial parts is dependent on the transpiration stream, and that the "excretion" of phosphorus into the xylem occurs only after considerable accumulation has taken place in the living cells of the root. Detailed results will be published elsewhere.

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